

## **FDI of German companies during globalization and deglobalization periods**

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Based on micro-level data of German companies from 1873 to 1927, we identified horizontal and vertical FDI applying a Knowledge-Capital model and analyzed individual FDI decisions. Our KC model revealed that market-driven FDI predominated; however, wage gaps and differences in human capital stimulated cost-driven FDI flows, which accounted for up to 10% of total FDI. On an individual level, large companies with high profitability conducted more FDI. Higher tariffs after WWI enhanced FDI, as companies could circumvent trade barriers – but declining openness reduced FDI. In spite of disintegration after WWI, the propensity to invest increased due to higher market concentration and firm specific investment patterns - albeit industry agglomeration effects were of minor importance.

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## **1. Introduction**

The end of the 19th century and the beginning of the 20th century marked a period of expanding demand, growth in productive capacity and rising exports in Germany. Germany became one of the leading industrial countries and took a pioneering role especially in the chemical, electric, and engineering industry until WWI (Henderson, 1975, p.173). Inventions such as the dynamo and the electric bulb were as important to the electric industry as synthetic dyes to the chemical industry or the development of steam engines to the engineering industry. Newly founded companies, like AEG or Siemens, achieved commercial success and entered the global stage. For instance, the fastest-growing electro-technical firm AEG invested 37 times abroad from 1873 to 1927. Already in 1892, AEG conducted their first FDI in the UK, soon after Emil Rathenau acquired a license for Edison's patents on lamps and the foundation of AEG in 1887 (see Pohl, 1988). Growing competition, especially in newly emerging industries with high growth potential, required entering new markets and reducing production costs, which triggered more and more FDI. After a period of enhanced economic and financial integration, WWI marked a turning point in international relations and a phase of protection and 'deglobalization' started, which allegedly contributed to the economic and social breakdown in the 1930s (Chase, 2004).

Our paper focused on FDI during the period 1873-1927 undertaken by German companies; hence, by covering periods of integration and disintegration, we had the unique opportunity to assess the impact of 'deglobalization' on FDI streams between countries and individual investment decisions. In a first step, we aggregated individual FDI to a panel of country level investment streams. We applied an extended Knowledge-Capital model (KC) to identify country characteristics that attracted FDI and to distinguish between market and cost-driven factors. The second step exploited our micro-level dataset on 948 individual FDI transactions of 377 joint stock companies, as well as a control group of 556 joint stock companies without FDI, as it allowed us to reveal company characteristics that stimulated

entering foreign markets. Finally, we investigated the endogeneity of FDI decisions using the heterogeneity of our panel data. In particular, we addressed firm and industry-specific investment patterns and therefore considered agglomeration effects and past individual investments.

Theoretical models of horizontal (market-driven) FDI focused on the trade-off between firm-level economies of scale and transportation costs, which suggests that in the absence of transportation costs firms prefer producing in one factory and exporting goods to foreign markets.<sup>1</sup> As transportation costs were relatively high from 1873 to 1927, we would expect a strong incentive to conduct horizontal FDI, and therefore companies developed production and distribution networks in host countries to meet local demand. In contrast, differences in factor intensities and factor prices cause vertical (cost-driven) FDI, which contends that companies shift parts of their production process or their entire production (leaving only the headquarter services in the home country), which are not skill-intensive, into countries with low wages for unskilled labor.<sup>2</sup> If countries with a high wage gap, namely lower real wages compared to Germany, and low relative skill levels (measured by the number of patents and primary school enrolment rates) attracted FDI, we could regard these investments as being primarily cost-driven. There are many terms used to describe different forms of vertical FDI like ‘slicing up the value chain’ coined by Krugman (1996), fragmentation (see Jones and Kierzkowski, 1990) or outsourcing; however, these forms were not technologically feasible in the first phase of globalization. Nevertheless, shifting the entire production and not just parts of it to a different country for the sake of lowering production costs was possible from a technological point of view. Accordingly, the research questions arise whether we can find vertical FDI in the period 1873-1927 and what type of vertical FDI

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<sup>1</sup> We refer to Markusen (1984) and Markusen and Venables (1998).

<sup>2</sup> Helpman (1984) and Helpman and Krugman (1985) developed the first theoretical models that explain vertical FDI.

was used. Carr, Markusen and Maskus (2001) combined both, market and cost-driven theoretical models, into the Knowledge-Capital (KC) model, which was empirically tested and modified by Braconier, Norbaeck, and Urban (2005) and Davies (2004). By aggregating our firm level FDI data, we applied a modified KC model to explain FDI across countries and to assess the relative importance of market and cost-driven FDI.

Our second approach disentangles individual FDI decisions and controls for firm and industry-specific effects. FDI decisions on the firm level are likely to be influenced by firm heterogeneity in terms of productivity (Helpman, Melitz and Yeaple, 2004; Bernard and Jensen, 1995) and agglomeration economies, which refer to positive externalities of an industry cluster in a particular host country that stimulate investment of firms in the same industry – see Greenaway and Kneller (2007) for a review of studies on agglomeration effects).

Our paper is organized as follows: the literature review stresses the current debate concerning horizontal and vertical FDI on an aggregated and micro-level and explores sources of heterogeneity between firms and industries (e.g. agglomeration effects). To assess the relevance of our study, the historical context is essential, as our period combines the experience of the first phase of globalization and the subsequent disintegration after WWI; the third section highlights our data collection efforts and shows descriptive findings; the fourth section presents our empirical results along the line of the following three questions: (1) were FDI flows between countries primarily market or cost-driven; (2) which factors influenced individual FDI decisions taking into account firm characteristics, industry-specific effects and the time pattern of FDI; (3) did protection and disintegration change investment incentives. Finally, we conclude and discuss our findings.

## 2. Literature review

The traditional view of capital flows based on a simple neoclassical model is that investments from capital abundant countries should flow to economies that have low relative capital endowment and are “rich” in other factors such as unskilled labor or natural resources.<sup>3</sup> In contrast, most empirical studies found that the largest share of FDI usually flows from rich, high-wage countries to other rich, high-wage countries. Hence, another strand of theoretical models – labeled New Trade Theory – evolved that was better able to explain the empirical facts. However, the models that explained horizontal (market-driven) activities (Markusen, 1984) failed to explain vertical (cost-driven) investments (Helpman, 1984) and vice versa. The Knowledge-Capital model (Carr, Markusen, and Maskus, 2001), in contrast, allowed horizontal and vertical activities and tried to explain international activities by country-specific factors. These factors include the joint market size of the home and host country, a dispersion factor (squared difference in real GDP), a measure for skill differences, and trade costs. The KC model assumes that the assets of knowledge-based firms can be used in many types of economies, including rich and human capital-abundant countries. It comprises as special cases the horizontal (market-driven) and the vertical (cost-driven) strategy: the horizontal strategy means that production processes are placed via FDI in countries that are very similar in human capital intensity to the headquarter economy (home market). The main motive is to gain market access more easily, by moving production into the proximity of foreign consumers, which lowers transport costs and circumvents other trade barriers (e.g. tariffs). In empirical studies, GDP of the target economy should be a strong driver for horizontal FDI, as it indicates market potential. In addition, similarities in terms of market size and endowment favor horizontal activities.

Quite contrary, the vertical strategy of FDI follows the idea that the stages of the production process are sliced up vertically, and each stage of production takes place where the

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<sup>3</sup> Lucas (1990) discussed the neoclassical prediction and its limitations.

factor costs are lowest: simple stages of production are relocated to low-wage, low-human capital countries, and human capital intensive processes take place in high-wage countries, for example headquarter services. The empirical implication would be that GDP of the host country should not matter much, and dissimilarity in terms of endowment and skill levels resulting in factor price differences (e.g. wages) should stimulate vertical activities. The modern form of slicing up the production process vertically requires a considerable amount of technology (e.g. information technology), which was not feasible in the pre-1927 period. Cost-driven FDI decisions and the shift of total production facilities; however, was possible (e.g. mining and access to raw material, factories in host countries), which the following section discusses in detail.

The KC model nests both models, and it predicts that companies employ the vertical or horizontal strategy, whichever might be most suitable for a given situation. Most empirical studies for the last few decades tended to confirm that market-driven FDI is the predominant strategy, but there is also some evidence for cost-driven FDI, especially from interviews with Central European firms that aim at using the wage differential between Central and Eastern Europe to slice up their production chain. In sum, most of the recent literature stressed that market access is the strongest motive for FDI, although vertical (cost-driven) motivations play a role in some situations (especially where factor price differences are only separated by relatively open borders, such as within the EU, or between the U.S. and Mexico). Accordingly, our estimation approach is motivated by Carr, Markusen and Maskus (2001), Markusen and Maskus (2001, 2002), and Blonigen, Davies, and Head (2003) that applied the KC model to macro-level data on FDI. In contrast to Carr, Markusen and Maskus (2001), who used sales of affiliates as dependent variable, we tried to explain FDI flows between Germany and host countries using country-specific factors (total market size, dispersion of real GDP, distance, difference in human capital measured by patent data and primary school enrolment rates) as explanatory variables. To assess the changing legal and political environment after

WWI, we included two measures, namely tariff barriers and an openness indicator (defined as value of merchandise exports relative to GDP).

Besides analyzing aggregated FDI streams, firm heterogeneity and the endogeneity of FDI have received much attention in the theoretical and empirical literature (Greenaway and Kneller, 2007; Helpman, Melitz and Yeaple, 2004; Bernard and Jensen, 1995). In particular, firm characteristics (e.g. productivity, size) might influence FDI decisions – but also industry structure seems to play a role. In specific, the agglomeration effect that refers to positive externalities experienced by firms that move into industry clusters might explain FDI patterns (the ‘Silicon Valley Effect’). For example, Japanese firms tend to cluster together in U.S. regions (Head, Ries, and Swenson, 1995). Those agglomerations provide information-processing advantages and – in the case of similar skills demanded on the labor market – industry clusters might be beneficial.

As only a few papers on FDI (for example Buch et al., 2005; Wagner and Schnabel, 1994) analyzed recent micro-level data, we stress that this is the first approach to investigate German micro-level FDI data in the first globalization period and the 1920s.<sup>4</sup> Most studies so far used aggregated data, whereas firm level studies have been only conducted for the U.S., Sweden, and Germany using data of the last two decades. In particular, long run studies that could make use of the special feature of the KC model – that behavior should be determined by varying economic environments – are lacking so far. One interesting recent study on Germany compared results at the firm level and at the aggregated level (Buch et al., 2005). The authors mobilized a very large panel dataset recorded by the *Bundesbank* and compared aggregated and individual FDI to target country’s GDP and similarity of GDP. On the aggregated level, an additional percent of GDP results in almost 1 percent additional FDI. This can be decomposed into (a) the increase of the number of affiliates and (b) a higher

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<sup>4</sup> Buch et al. (2005) pointed at the limitations of studies that only focus on macroeconomic or aggregated data, as they did not allow assessing firm-specific characteristics and incentives for FDI.



investment per affiliate. Buch et al. (2005) found that the investment per affiliate accounts for about one third of additional FDI volume, whereas additional affiliates account for the remaining two thirds (assuming that there is no omitted variable and measurement error bias in their regressions). The authors also uncovered that similarity of GDP of the host country compared to Germany, which is the only headquarter economy in this study, has a positive influence on the size of the investment and sales per affiliate, whereas protection has a negative influence.

The economic and political context during our investigation period might affect investment patterns and hence is a central aspect of our study, as it allows assessing the impact of globalization and disintegration on aggregated FDI flows and on individual FDI decisions. The economic history of foreign investment was multi-faceted and can be outlined here only briefly. Wilkins (1970, 1974, 1989, and 2004) described FDI of U.S. firms abroad and of foreign firms in the U.S. in a series of monographs. Unfortunately, for other countries including Germany, a systematic data collection and evaluation of FDI is yet missing – see Hagen (1997) on German investments in the UK and Schaefer (1995) on portfolio investments. Broadly, the period can be divided into an early phase of globalization before WWI, and a post-war environment. In the pre-war period, FDI took place in a liberal world, in which trade blocs and similar constraints were largely unknown. On a regional basis, municipalities restricted foreign investment, since they were influenced by local employers afraid of rising wages due to increased competition on the labor market (Baten, 1993, p. 47). Yet if one municipality generated administrative obstacles, the investing firm could easily target another location. Besides the lack of barriers for FDI, any subsidies (tax breaks etc.) were also absent. During the 1920s, a large number of countries tried actively to attract foreign investment, although tax breaks as a systematic strategy was still not common. Instead, more rapid administrative procedures were offered. To highlight the influence of WWI and the disintegration phase, Table 1 reports the largest recipients of German FDI in the

pre-1914 and post-1914 period. The UK and Austria had by far the largest share before WWI, whereas the U.S., Italy, Russia, and France were apparently also interesting markets. In the post-war period, there was a certain change. German FDI went more often to neighboring countries, such as post-war Poland and especially the city of Danzig, which was under the League of Nation administration after Germany lost WWI, but economic ties with Germany were still important. Neighboring Switzerland was the third most important destination, whereas it had not appeared on the pre-war top 10 list. Austria remained in the lead after WWI, and Czechoslovakia (nowadays Czech and Slovak Republic) became more important. But still, the US attracted about 7% of FDI before and after WWI with no apparent difference. Russia disappeared from the list of potential host countries after 1917 and the Soviet Union did not replace it, as the communist country would not have accepted German FDI (at least officially).

(Insert Table 1)

The FDI towards the U.S. and other war enemies of WWI was influenced by the war policies of seizing foreign property. For example, in the U.S., German FDI was de facto expropriated in 1917, although a number of companies found either American stooges or people living in neutral countries (such as Switzerland) to continue the activities of their foreign plants and sales units (Wilkins 2004, pp. 113-114). For those investors who were not able or willing to initiate such a solution, the debates about returning “alien trusts” were long and complicated. Only small investments worth less than US\$ 10,000 were returned by the law of 1923, i.e. small sales units might have been given back. One of the large foreign affiliates owned previously by the Metallgesellschaft, even caused a lawsuit about bribery (Wilkins 2004). The complicated situation in some of the previous opponents of war countries might have stimulated additional FDI, as the plants and sales units, which were not restored fast enough, needed to be replaced by new FDI. Nevertheless, investments in former enemy

countries might have been considered more risky than before. In sum, those push and pull-factors might to a certain extent have offset each other, as the U.S., the UK and France were still among the top 10 host countries.

Another issue which had changed between the pre-war and post-war world was the emergence of trade blocs. It became even more important during the 1930s when Germany aimed at increasing trade with East and Southeast Europe, and it might be that FDI followed trade relations. However, already during the 1920s, the Sterling and the Franc trade blocs became more consistent and closed than before WWI. Again, there might have been counter-acting forces. A trade bloc with its non-tariff restrictions against non-members (indirect barriers to trade) had a similar effect as a tariff: trade was limited and property rights might have been more difficult to enforce, but the missing trade might also have initiated additional FDI to substitute trade. It is difficult to reveal empirically the effect of the Sterling and Franc trade blocs for German FDI, as those were dominated by former German war enemies. Hence, the decline of German FDI in the UK might have been caused by the Sterling zone as well as the problematic relationship with former war enemies. In sum, while the economic and political environment between the pre- and the post-war period has changed quite substantially, it is not clear whether there was a pronounced effect on German FDI because of counter-acting forces. Looking at the list of the most frequently chosen target countries, the UK clearly lost its dominance to Switzerland, but otherwise the list of top host countries hardly changed after WWI.

### **3. Data and construction of variables**

Our analysis included all joint stock companies listed on German stock exchanges and documented in the 'Handbücher der deutschen Aktiengesellschaften' from 1873 to 1927 that undertook FDI. Consequently, 377 joint stock companies conducted in total 948 FDI

transactions during the investigation period. To account for companies that did not undertake any FDI, we randomly selected 556 joint stock companies as a control group. Generally, we have information about the year, the destination (town and country), the industry, and the amount of investment of the respective FDI transaction. Our dataset provides information on FDI of German companies in 55 countries and 37 industries. The 10 most important countries were by far Austria-Hungary (current borders, after WWI: Austria and Hungary) and the UK, followed by France, USA, Italy, Russia (SU after WWI), Poland (before WWI: part of neighbor empires), Switzerland, Netherlands, and Czechoslovakia (before WWI: part of Austria-Hungary). Fig. 1 plots the relative importance of specific industries regarding FDI. We observe a particularly high number of FDI in the electric and machinery industry with a share of about 40% of total FDI, followed by the chemical and metal processing industry. None of the remaining industries accounted for more than 6% of total FDI.<sup>5</sup>

(Insert Fig. 1)

Focusing on the type of FDI provided by the 'Handbücher der deutschen Aktiengesellschaften', we can identify to some extent the motive for FDI (access to raw material, production, sales) and the mode of market entry (equity stake, merger, Greenfield investment). Due to data limitations, we cannot identify the type of FDI for all FDI transactions; nevertheless, we obtain an overview of the relative importance of different motives and modes of entry. Table 2 shows that Greenfield investments accounted for 72% of total FDI and cross-border mergers were of marginal importance; however, 26% of FDI was based on equity stakes. Predominantly, FDI referred to starting production and sales operations in a host country, but 27% of FDI focused on sales (e.g. sales agencies) and 13% of FDI was due to production. In the mining and steel industry, FDI was important to obtain access to raw material (e.g. mines, forests). Consequently, some forms of FDI (e.g. shift of

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<sup>5</sup> We account for the four most active industries concerning FDI by including dummy variables into our regression models.

entire production, mining) – certainly different from modern forms (e.g. outsourcing of finance function) – were observable and given the level technical progress feasible.

(Insert Table 2)

Following Carr, Markusen and Maskus (2001), we estimated the KC model to disentangle vertical and horizontal investment activities. Accordingly, our regression models refer to the following country-specific variables: (1) the sum of real GDP, (2) the squared difference in real GDP of Germany and the respective host country (dispersion factor), (3) the distance between Germany and the respective host country, and (4) the skill difference between home and host country. From a theoretical perspective, large and similar countries in terms of factor endowments and market size should attract horizontal activities, as market access seems to be the most important motive. In contrast, skill differences should result in factor price differences and hence could trigger vertical FDI flows, as countries can shift production to benefit from factor price differentials. Based on Maddison's (1995) GDP time series with constant prices, we derive the sum of real GDP of Germany and the host country (*sum\_gdp*) and calculate the squared difference in real GDP, which indicates the degree of similarity in terms of market size (*dispersion*). To account for transportation costs and as a common proxy for cultural differences, we include the distance in km between the capitals of the home and host country (*distance*). Adjacent countries tend to have closer economic linkages due to low transportation costs, similar culture and familiar regulatory frameworks (e.g. legal system). Extending the idea of cultural similarity, we controlled for the official language of the host country (*language*). To account for skill differences, we used two indicators, namely the number of patents of foreign firms (located in the host country) in Germany (*patent*) and primary school enrolment rates.<sup>6</sup> Patent data provide an output measure for skills in an economy compared to input-oriented measures like the number of scientists

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<sup>6</sup> To ensure that patents are of high importance for the respective company, we followed Streb, Baten and Yin (2006) who distinguished between low and high-value patents.

per 1000 workers or primary school enrollment rates (Carr, Markusen, and Maskus, 2001). As Germany can be regarded as skill abundant country, a high skill level in a host country suggests that the host country is more similar compared to Germany. Using the number of patents (*patents*) as an indicator for the host country's skill level exhibits inherent limitations; in particular, FDI flows might lead to patents to protect newly entered markets, which results in an endogeneity bias. Consequently, primary school enrollment rates serve as a more robust indicator of skill levels, albeit schooling is an input measure. To measure the skill difference in terms of primary school enrollment rates, we calculated the difference of the host country's enrollment rate and the top 25% of all host countries (*enrollment*); thus, a negative value indicates that the respective host country has lower enrollment rates compared to the leading 25% of host countries.

Our investigation period covers the first phase of globalization and a period of disintegration and protection following WWI; thus, we attempted to measure the impact of protection and disintegration on FDI streams. On the one hand, we would expect more FDI between well-integrated markets, if the costs of production are substantially different (vertical activities) or the proximity of production to consumer markets plays a large role (horizontal activities). On the other hand, FDI was often used as a substitute for trade, when tariff barriers were high. In particular, if intangible assets were an incremental part of the firm's product – for instance special expertise, reputation, and brand – capital could be moved behind tariff walls by setting up a production facility in the selected host country. For example, the Singer sewing machine company was a famous U.S. multinational, which often moved behind tariff walls and even pretended to become a 'native' company of respective host countries (Wilkins, 1986; O'Rourke and Williamson, 1999, p.218).

We used the ratio of custom revenues to total imports for a given country and time to construct a measure of protection (*protect*). One major source of data was Accominotti and Flandreau (2006). They collected protection rates for Austria-Hungary, Belgium, Switzerland,

Spain, France, the UK, Italy, Netherlands, Russia, and the U.S. for the period 1840-1890. Another important source was Rubio's (2006) data for Latin American countries; thus, we were able to fill gaps until 1910 for some countries. Finally, we used average tariff rates from the quite comprehensive Clemens and Williamson (2004) dataset for the 1920s. However, our protection variable might be biased if there are very high tariffs for some goods among others with lower protection. As the imported volume of a good with a high tariff might decrease, the weight of a highly protected good reduces in the calculated overall measure of protection. This effect might understate the degree of protection of the respective host country. Therefore, we added an additional indicator that quantifies the degree of openness (*openness*), which is based on the value of merchandise exports relative to GDP.<sup>7</sup> Finally, to quantify factor price differences directly, our regression model incorporated the difference in real wages based on Williamson (1995) (*wagediff*).

To address firm heterogeneity and the endogeneity of FDI, we analyzed in a second step individual FDI decisions and accounted for the time pattern of investments. Besides our measures for protection and openness that might influence individual FDI decisions (e.g. tariff barriers might increase FDI),<sup>8</sup> we followed Helpman, Melitz and Yeaple (2004) by analyzing the relationship between firm productivity and FDI. They emphasized that firms conducting FDI are not only larger, but also more efficient and productive than firms that produce for the home market or choose to export. In contrast to Helpman, Melitz and Yeaple (2004) that used the firm size dispersion as a measure of firm productivity, we measured productivity directly by calculating the return on equity (*ROE*).

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<sup>7</sup> Based on Maddison (2003).

<sup>8</sup> In the case of our control group that contains companies without FDI, we use the median of the level of protection and openness based on the FDI transactions in the respective year.

Economies of scale on the firm and plant level could influence FDI decisions, as high economies of scale on the firm level relative to the plant level make horizontal FDI more likely (Brainard, 1993; Markusen and Venables, 1998);<sup>9</sup> hence, we take the log of total equity as proxy of firm size to control for size advantages (*size*).<sup>10</sup> Besides the interrelation of firm size and economies of scale, larger companies have easier access to capital markets. Thus, FDI is easier to finance, and cost of capital is lower, which makes FDI more attractive.<sup>11</sup> Moreover, the year of the establishment of a company (*foundation*) controls for the degree of firm's maturity. To control for market concentration in Germany, the Herfindahl Index (*HI*) served as a proxy. The index refers to the sum of squared market shares of firms within the same industry; a high Herfindahl Index indicates a high level of concentration. Typically, the Herfindahl index is standardized to create a range of index values between 0 and 100 (low to high level of concentration). The definitions of variables and sources used in the empirical part of the paper are summarized the appendix.

To obtain an overview regarding the firm characteristics of companies that conducted FDI and companies that did not, Table 3 reports means, standard deviations, 5 and 95-percentiles for firm size, value of FDI relative to total assets, return on equity and year of establishment. Based on group-wise descriptive statistics, Table 3 underlines that companies with FDI activities tended to be larger, and more profitable indicated by a higher return on equity (ROE). Furthermore, there seem to be industry-specific effects that need to be analyzed

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<sup>9</sup> Plant level of scale economies cannot be measured due to a lack of data.

<sup>10</sup> Note that other proxies like the number of employees would reduce the number of observations considerably due to missing data. In addition, alternative measures are highly correlated with our proxy.

<sup>11</sup> Tilly (1982) argued that the companies' laws of 1884 and the new exchange law established 1896 favored larger companies. For instance, the law required that the minimum issue volume had to exceed one million Mark. Hence, a larger company had advantages to finance expansion by issuing new shares. The companies' law and the new exchange law mainly determined the legal framework in the pre-1914 period.



further; particularly, the size of FDI relative to total assets was larger in the metal industry compared to the electric, machinery and chemical industry.

(Insert Table 3)

## 4. Empirical results

### 4.1. Was FDI market or cost-driven?

Following Carr, Markusen and Maskus (2001), Markusen and Maskus (2001, 2002) and Blonigen, Davies, and Head (2003), we specified KC models to explain cross-country FDI flows and to identify whether FDI was driven by market access (horizontal activities) or cost savings (vertical activities). Accordingly, we aggregated individual FDI flows for every year and country for which we could detect FDI flows.

Therefore, log investment streams (aggregated to country FDI streams based on individual FDI) served as dependent variable. Using Hoffmann's (1965) price index for Germany, we deflated the value of FDI. As the value of FDI was not always reported, we have only 376 underlying observations that we aggregated to 180 country level FDI streams.<sup>12</sup> To describe the global geography of German FDIs during this period, Fig. 2 highlights the residual FDI per billion GDP after accounting for distance and common language; hence, the residual value is adjusted for spatial and cultural proximity. It is apparent that Scandinavia received much less German FDI per billion GDP, after accounting for its proximity. Also Southeastern Europe, Turkey, and Egypt did receive only modest amounts, and the same applies to Canada, Portugal and Spain, whereas the rest of the world received above-average FDI streams. Accordingly, spatial and cultural proximity alone did not explain investment

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<sup>12</sup> Balance sheet information could help to overcome this data limitation; however, we cannot distinguish between new FDI and old stakes in foreign enterprises. In spite of 552 balance sheet observations regarding the foreign activities of a company (minority stakes, foreign subsidiaries etc.), we cannot rely on this information.

streams sufficiently, and a more elaborate KC model is needed to distinguish between different types of FDI. The following basic regression equation is used to analyze cross-country FDI streams. Host countries are indexed  $f$  and time is indexed  $t$ .

$$\log(\text{invest}_{ft}) = \alpha + \beta_1 \text{sum\_GDP}_{ft} + \beta_2 \text{dispersion}_{ft} + \beta_3 \text{distance}_f + \beta_4 \text{language}_f + u_{ft} \quad (1)$$

Model A is our basic model that includes the gravity component (*sum\_GDP*), the dispersion term (*dispersion*) that highlights the degree of dissimilarity between Germany and the host country in terms of market size, distance as a proxy for transportation cost and cultural differences (*distance*) and the use of the German language as additional cultural component (*language*). We extended the basic model A by inserting wage differences (*wagediff*), as lower wages in host countries might trigger cost-driven FDI, for firms can reduce costs by shifting their labor-intensive production to a labor abundant country.<sup>13</sup> Wage differences can be the result of differences in skill endowment, and thus model B considers the number of patents (*patent*) as human capital indicator. Due to an alleged endogeneity bias, since patents could depend on FDI, models C to E use primary school enrollment rates (*enrollment*) as human capital measure.

Model D was extended further by incorporating a measure for protection (*protect*) to control for differences with regard to trade policies. As our protection measure (custom revenues divided by imports) might not indicate the degree of disintegration and might be biased (as discussed in the previous section), model E embeds the value of merchandise exports relative to country's GDP as an indicator of openness (*openness*).

(Insert Table 4)

Table 4 reports the results of the KC models with different measures for skill differences and market integration. The signs of the coefficients are interesting; as it shows that cost-driven FDI was important at least in the case of some host countries with low skill levels measured by primary school enrollment rates (negative values indicate enrollment rates

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<sup>13</sup> We collected real wages for host countries in the respective year of FDI inflows.

below the top 25% of all host countries) and a high wage gap compared to Germany (positive values indicate that the real wage in Germany exceeds the real wage in the host country).

The standard gravity model A with the sum of GDP, dispersion factor, distance, and common language dummy has explanatory power in our country panel. Henceforth, we confirmed the presence of FDI motivated by horizontal strategies: large host countries attracted more FDI due to their large markets, and the dispersion factor has a strong negative impact on FDI flows, which shows that countries of similar size with regard to their GDP exhibited higher FDI flows. Distance did not have the alleged negative impact on FDI; hence, it is not a robust predictor for cultural and institutional similarities. Common language has an insignificant effect; thus, there was no apparent language barrier. Concerning differences in human capital and real wages, Table 4 reveals that cost-driven FDI was relevant for some countries that had lower wages compared to Germany (see model B to E). Interestingly, the number of patents (*patent*) did not seem to be a robust variable to explain skill differences (see model B). Patents might be driven by FDI flows, as firms tried to obtain patents to secure their markets and to deter market entry. Consequently, model C to E replaced patents as human capital measure by primary school enrollment rates, which exhibited a significantly negative impact on FDI streams. Countries with low primary school enrollment allowed *ceteris paribus* complementarities to German high-skilled production factor and hence attracted vertical activities in some cases.<sup>14</sup>

(Insert Table 5)

To illustrate our findings, Table 5 shows partial effects predicted by model E (see Table 4) for all countries, low skill countries that exhibit primary school enrollment rates below the 25-percentile, low wage countries with the highest wage gap (top 25-percentile) and selected countries with the lowest skill level (India), highest wage difference (Egypt) and

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<sup>14</sup> Primary school enrollment rates also seem to be a good general indicator for the level of development and industrialization, as correlation between enrollment rates and real GDP per capita was 0.78.

high degree of similarity in terms of market size (France). India exhibited the lowest primary school enrollment rates, and hence model E predicts that 9.3% of FDI should be driven by skill (4.8%) and wage differences (4.5%). Egypt attracted 6.3% of FDI due to the highest wage gap compared to Germany. Therefore, vertical drivers of FDI did not explain a substantial part of investment streams. Countries more similar to Germany, such as France, showed a low level of FDI due to wage or skill differences, namely 0.5%. Accordingly, we confirm FDI was mainly market-driven, which is in line with findings for recent investigation periods; however, to some extent wage and skill differences mattered for FDI decisions. In addition, protection due to tariff barriers did not influence aggregated FDI streams – but market openness (*openness*) exhibited a significantly positive effect, albeit the magnitude of impact was negligible (see Table 5). Furthermore, trade barriers and openness might influence individual investment decisions, which the following section analyzes. Compared to Carr, Markusen and Maskus (2001), our KC model exhibited rather low levels of explanatory power with an adjusted R-squared between 20% and 30%; hence, we tested for a potential omitted variable bias using the Ramsey RESET test and confirmed that our model specifications did not suffer from an omitted variable bias. The low level of explanatory power might be due to using FDI streams as dependent variable and not sales of affiliates (Carr, Markusen and Maskus, 2001), which are less volatile.

#### 4.2. Which companies conducted FDI?

After analyzing aggregated FDI flows, we modeled the decision “to invest or not to invest” from a business perspective; accordingly, we used firm-level data for the whole period from 1873 to 1927 and tried to explain individual FDI decisions. Besides tariff barriers (*protect*) and market openness (*openness*) used in the KC models (see Table 4), we incorporated firm-specific variables to quantify firm profitability (*ROE*), firm size (*size*) and firm’s maturity measured by the year of establishment (*foundation*). We also considered industry effects

(denoted j) by using conditional (fixed-effects) logit models. Accounting for the most active industries in terms of FDI, we used four main categories (chemical, electric, machinery, and metal). Besides these major industries, we could distinguish 37 different sub-industries. Consequently, we run the following logit models that address the binary decision concerning individual FDI.

$$\text{fdi}_{it} = \alpha + \beta_0 \cdot \text{protect}_{it} + \beta_1 \cdot \text{openness}_{it} + \beta_2 \cdot \text{size}_{it} + \beta_3 \cdot \text{ROE}_{it} + \beta_4 \cdot \text{foundation}_i + u_{it} \quad (2)$$

Table 6 shows the regression output for the basic model without industry effects (model F), the conditional logit model with 37 industries (model G) and a specification with the four major industries (model H). Model I also embedded the openness indicator to illustrate the effect of 'deglobalization' in the 1920s leading to lower levels of market integration and the proxy for tariff barriers (*protect*).

(Insert Table 6)

Firm size stimulated FDI indicating that economies of scale (on the company level), easy access to capital markets and other size advantages like market power were relevant for conducting FDI. Accordingly, our findings confirm Brainard (1993) and Markusen and Venables (1998), as they argue that firm level scale economies drive FDI. Profitability made FDI more likely; hence, profitable firms could use their factor advantages to enter foreign markets. Therefore, firm heterogeneity regarding profitability explained the propensity to invest abroad, which is in line with Helpman, Melitz and Yeaple (2004). The year of foundation, shows a negative but not significant impact (after controlling for industry effects) on the probability to conduct FDI. Protection stimulated FDI flows; however, the magnitude of impact is rather limited and needs further investigation. As a consequence, we can conclude that increasing tariffs created incentives for companies to circumvent trade barriers by shifting their production facilities. Yet disintegration of markets measured by our openness indicators seemed to reduce the probability of FDI, since openness declined after WWI. To

determine the magnitude of impact of the identified factors and to explore firm heterogeneity and investment patterns, the following section expands our model further.

#### 4.3 Heterogeneity and endogeneity of FDI decisions: A firm and industry-specific view

To exploit path dependency of individual FDI, we included an indicator variable (*past\_fdi*) that takes the value one if the same company conducted FDI before (within a ten-year window) and zero if the firm did not undertake any FDI. Out of 948 FDI transactions, 459 firms conducted FDI previously and 120 firms invested in the same country in the past ten years. A positive coefficient of *past\_fdi* would indicate that investments exhibited path dependency; therefore, past FDI triggered more FDI in the future. Apart from this firm-specific investment pattern, industry-wide clustering might affect location and investment choice. Following the literature on firm heterogeneity and agglomeration effects (Greenaway and Kneller, 2007), the logit model in equation 3 considers industry clusters in the four main industry categories (metal, machinery, chemical and electric) by counting the number of FDI of firms within the same industry in the respective host country during the last decade. Table 7 shows our findings and highlights that agglomeration effects did not influence individual FDI decisions – but past investments on the individual level made subsequent investments more likely.

$$\begin{aligned} \text{fdi}_{it} = & \alpha + \beta_0 \cdot \text{protect}_{it} + \beta_1 \cdot \text{openness}_{ft} + \beta_2 \cdot \text{size}_{it} + \beta_3 \cdot \text{ROE}_{it} + \\ & \beta_4 \cdot \text{foundation}_i + \beta_5 \cdot \text{past\_fdi}_{it} + \beta_6 \cdot \text{HI}_1 + \sum_{j=1}^4 \chi_j \cdot \text{agglomeration}_j + u_{it} \end{aligned} \quad (3)$$

The models J and K expanded our previous logit model (see equation 2) by adding the time pattern of individual FDI (*past\_fdi*, only model J) and agglomeration effects (*agglomeration*) for the four major industries (labeled *j* in equation 3). Model L and M also included the standardized Herfindahl index, as a measure for market concentration, for the 37 sub-industries (labeled *l* in equation 3). Consequently, model L and M captured individual

patterns of FDI, agglomeration effects and industry concentration. The difference between model L and M is that a logit model produced the results of model L, whereas model M was based on a probit model. The logit model allows modeling more extreme probability distributions and hence has thicker tails than the probit distribution. As there is no theoretical argument for preferring either the logit or probit model, we ran both specifications and obtained similar results concerning the significance of the explanatory variables. This underlines that our results are robust. Apart from statistical significance, the directions of influence are the same; however, the magnitudes of impact differ, which is due to the different underlying probability distributions. For example, the size of the HI coefficient looks quite different.

(Insert Table 7)

Firm size and profitability had a significant and positive impact on FDI. Interestingly, the impact of tariff barriers (*protect*) on FDI activity is significant on the individual level – but not on the aggregated level as shown in our KC models. Higher tariff barriers stimulated FDI, as firms could circumvent trade barriers, whereas lower levels of market openness hindered FDI; therefore, the impact of ‘deglobalization’ on FDI decisions is not straightforward to assess. To illustrate the magnitude of impact of the different firm, industry and country-specific factors, we calculated marginal effects and used the changes in dependent variables to determine the partial impact on the propensity to invest based on model M. Table 8 shows that the propensity for conducting FDI increased by 4.5% from the pre-1914 to the post-1914 period, which was mainly due to a pronounced increase of industry concentration. Higher tariff barriers increased the investment probability by 0.3%, whereas the lower degree of market openness reduced the investment probability by 0.6%.

(Insert Table 8)

## 5. Conclusion

We analyzed a new database on German FDI conducted by joint stock companies between 1873 and 1927. Our first approach investigated the destination choice of German companies going abroad by aggregating individual investment streams by host countries and by the time of investment, which resulted in an unbalanced panel of cross-country investment streams. Following Carr, Markusen and Maskus (2001), Markusen and Maskus (2001, 2002) and Blonigen, Davies, and Head (2003), our KC model confirmed the predominant role of market-driven investment strategies already in the late 19<sup>th</sup> and early 20<sup>th</sup> century. Interestingly, we also found some evidence for cost-driven FDI, as wage differentials caused FDI flows to low wage countries. In addition, differences in human capital measured by primary school enrollment rates triggered cost-driven FDI, since German firms brought their proprietary knowledge with them and hence did not have to rely on human capital of host countries, but could use complementary advantages. We also assessed the effect of distance, both geographic and cultural, the latter captured by the proxy common language. Yet, after accounting for gravity (in terms of GDP) and dispersion (differences in GDP), spatial and cultural proximity did not seem to have a pronounced impact on FDI streams. On the aggregated level, the increase in trade barriers during the 1920s, which started a ‘deglobalization’ period, had no impact on FDI streams – but lower levels of integration measured by our openness indicator deterred foreign investments.

The market environment concerning tariffs and market openness, however, influenced individual investment decisions significantly, although the impact of tariffs seemed to be positive declining market openness hampered FDI. In total, the effect of tariffs and openness is minor compared to firm and industry-specific variables. Contrarily, Buch et al. (2005) found that the level of market protection has a negative impact on FDI. Due to the increase in market concentration in the German home market – measured by the Herfindahl Index – companies conducted more FDI. Furthermore, our logit and probit models emphasized the importance of firm size and efficiency for FDI in the late 19<sup>th</sup> and early 20<sup>th</sup> century, which is



in line with Helpman, Melitz and Yeaple (2004). Past firm-specific investment decisions influenced subsequent FDI; thus, we confirm path-dependency on the firm level, although our models reject path-dependency on the industry level. As a consequence, industry agglomeration effects did not seem to matter in the period 1873-1927, which differs from empirical evidence for later periods.

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**Table 1** Top 10 host countries and their FDI share in the pre and post-1914 period

	pre- 1914		post- 1914
UK	14.9%	Austria	10.3%
Austria	14.4%	Poland	9.1%
France	8.2%	Switzerland	9.1%
USA	7.0%	Czechoslovakia	7.4%
Italy	6.6%	USA	6.9%
Russia	6.5%	UK	6.3%
Hungary	4.8%	Netherlands	6.3%
Poland	4.0%	Italy	5.1%
Netherlands	3.1%	Brazil	3.4%
Spain	3.1%	Spain	2.9%

**Table 2** Types of FDI and modes of entry

Modes of entry			Type of FDI			
	Number	Percent		Number	Percent	
Greenfield	681	72%	Sale & production	259	27%	
Equity stake	250	26%	Sale	258	27%	
Merger	10	1%	Production	127	13%	
Unspecified	7	1%	Raw material	37	4%	
			Unspecified	267	28%	
Total	948			948		



**Table 3** Descriptive statistics

		Obs.	Mean	Std. Dev.	Bottom 5%	Top 5%
<b>Panel A: All firms</b>						
Without FDI	size	595	14.5	1.3	12.1	16.6
	ROE	595	5.8	29.7	-31.3	30.8
	foundation	594	1895.4	16.3	1868	1922
With FDI	FDI/assets	221	12.6	40.1	0.2	36.3
	size	948	15.8	1.5	13.7	18.6
	ROE	948	10.1	22.4	-24.4	35.6
	foundation	948	1894	16.5	1870	1922
<b>Panel B: Chemical industry</b>						
Without FDI	size	70	14.1	1.2	12.2	15.8
	ROE	70	11.8	18.9	-12.5	37.6
	foundation	69	1891.8	19.3	1855	1920
With FDI	FDI/assets	20	8.4	13.5	0.1	39.8
	size	131	15.3	1.1	13.8	16.9
	ROE	131	11.8	24.4	-24.4	34.2
	foundation	131	1894.1	16.1	1865	1913
<b>Panel C: Electric industry</b>						
Without FDI	size	83	14.7	1.4	12.8	16.7
	ROE	83	10.5	8.9	-2.2	23.7
	foundation	83	1900.2	9	1884	1910
With FDI	FDI/assets	39	5.1	9.2	0.1	21.5
	size	232	17.2	1.4	14.6	18.7
	ROE	232	12.5	9	1.3	20.6
	foundation	232	1897.5	13.1	1883	1927
<b>Panel D: Machinery industry</b>						
Without FDI	size	106	14.3	1.4	11.5	16.4
	ROE	106	2.5	34.2	-63.3	28.9
	foundation	106	1897.5	14.8	1871	1922
With FDI	FDI/ assets	26	5.4	6.8	0.2	17
	size	196	15.4	1	13.7	16.8
	ROE	196	0.2	32.3	-63.1	38.6
	foundation	196	1898.5	17.8	1872	1922
<b>Panel E: Metal industry</b>						
Without FDI	size	96	14.5	1.2	12.2	16.5
	ROE	96	0.7	32.8	-46.3	24.7
	foundation	96	1898.9	14.3	1871	1922
With FDI	FDI/assets	24	10.2	14.9	0.7	26.5
	size	88	15.7	1.8	13.3	18.9
	ROE	88	15.5	30.7	-1.3	44.1
	foundation	88	1892.8	12.6	1872	1909

ROE and FDI relative to total assets is in percentage points. Size refers to the natural logarithm of total equity and is denominated in German current and deflated. The appendix contains more details on the construction of variables and data sources.

**Table 4** OLS estimation of gravity models on country level

	Model A	Model B	Model C	Model D	Model E
	country_fdi	country_fdi	country_fdi	country_fdi	country_fdi
sum_gdp	8.950*** (4.78)	12.2435*** (5.39)	17.1629*** (5.73)	33.6375*** (4.16)	20.9347*** (4.91)
dispersion	0.0038 (0.04)	-0.3862*** (-3.64)**	-0.5990*** (-4.23)	-1.3643*** (-3.06)	-0.6753*** (-3.55)
distance	-0.0011** (-2.26)	-0.0001 (-0.35)	-0.002 (-0.51)	-0.0008 (-1.08)	0.0004 (1.08)
language	1.2431 (0.28)	0.2633 (0.0.11)	0.1711 (0.06)	9.4020 (1.55)	0.5672 (0.16)
patents	-	0.6343 (0.87)	-	-	-
enrollment			-0.2217*** (-2.91)	-0.4140*** (-3.56)	-0.2812*** (-2.89)
wagediff	-	11.3422*** (2.82)	10.7228*** (2.67)	28.3506** (2.16)	17.6410*** (3.46)
protect	-	-	-	0.2757 (0.59)	-
openness	-	-	-	-	0.7321*** (2.84)
constant	-200.724*** (-5.04)	-255.7613*** (-5.37)	-364.0087*** (-5.72)	-722.2674*** (-4.24)	-465.5863*** (-4.93)
observations	180	150	149	102	136
adj. R-squared	0.213	0.268	0.263	0.277	0.300
Ramsey RESET	4.10 (0.008)	10.77 (0.000)	7.37 (0.000)	4.47 (0.006)	7.36 (0.000)

Robust t statistics in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

**Table 5** Illustration of partial effects

	All countries	Low skill	Low wage	India	Egypt	France
enrollment	1.0%	3.1%	3.0%	4.8%	4.5%	-0.1%
wagediff	0.1%	1.6%	2.1%	4.5%	6.3%	0.6%
openness	1.8%	0.9%	0.7%	0.3%	0.0%	1.2%

The partial effects refer to expected FDI streams forecasted by model E in Table 4. To illustrate the relative importance of selected explanatory variables, the partial effects are expressed in percent of the total predicted FDI flow. The assessment is based on average values of explanatory variables for all countries, a sub-sample of countries or individual countries.

**Table 6** Logit and conditional (fixed-effect) logit models

	Model F	Model G	Model H	Model I
	Basic model	Industry-effects	Major industries	Openness measure
	fdi	fdi	fdi	fdi
protect	0.022** (2.18)	0.020* (1.89)	0.020** (2.00)	0.066*** (5.41)
openness	-	-	-	0.139*** (6.83)
size	0.751*** (12.35)	0.848*** (12.02)	0.771*** (11.93)	0.800*** (11.70)
ROE	0.817** (2.39)	0.815** (2.10)	0.857** (2.40)	1.189*** (3.04)
foundation	-0.010* (-1.78)	-0.004 (-0.64)	-0.009 (-1.57)	-0.005 (-0.80)
chemical	-	-	0.609*** (2.65)	0.520** (2.18)
electric	-	-	0.002 (0.01)	-0.068 (-0.30)
machinery	-	-	0.424** (2.06)	0.352* (1.64)
metal	-	-	-0.637** (-2.52)	-0.669** (-2.53)
constant	6.642 (0.63)	-	4.777 (0.43)	-5.653 (-0.50)
observations	1023	987	1023	992
pseudo R <sup>2</sup>	0.192	0.209	0.209	0.246

z statistics in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

Table 6 reports coefficients based on logit models.

**Table 7** Firm heterogeneity and agglomeration effects

	Model J	Model K	Model L	Model M
	fdi	fdi	fdi	fdi
protect	0.0769*** (5.07)	0.0654*** (5.42)	0.0622*** (3.40)	0.0406*** (4.65)
openness	0.1966*** (6.80)	0.1322*** (6.46)	0.1388*** (4.06)	0.0946*** (6.05)
size	0.4641*** (5.72)	0.7816*** (11.75)	0.2494** (2.52)	0.1879*** 4.13
ROE	1.6339*** (3.48)	1.1079*** (2.87)	1.0038 (1.60)	0.9726*** (3.33)
foundation	-0.0155** (-2.17)	-0.0061 (-1.06)	-0.0153 (-1.62)	-0.0079 (-1.80)
past_fdi	4.6041*** (10.68)		1.9899*** (4.14)	1.6719*** (8.33)
HI			0.6847*** (11.00)	0.0666*** (7.31)
<b>Agglomeration effects</b>				
chemical		0.1015** (2.62)	0.0318 (0.50)	0.0323 (1.12)
electric		-0.0083 (-0.31)	-0.0658 (-1.19)	-0.0396 (-1.75)
machinery		0.0324 (0.86)	-0.0237 (-0.39)	-0.0074 (-0.27)
metal		-0.198** (-2.69)	-0.1064 (-1.00)	-0.0736 (-1.54)
constant	18.4983 (1.32)	-2.4776 (-0.22)	20.9612 (1.14)	9.9753 (1.16)
observations	928	994	928	928
p-seudo R	0.445	0.246	0.727	0.496

z statistics in parentheses

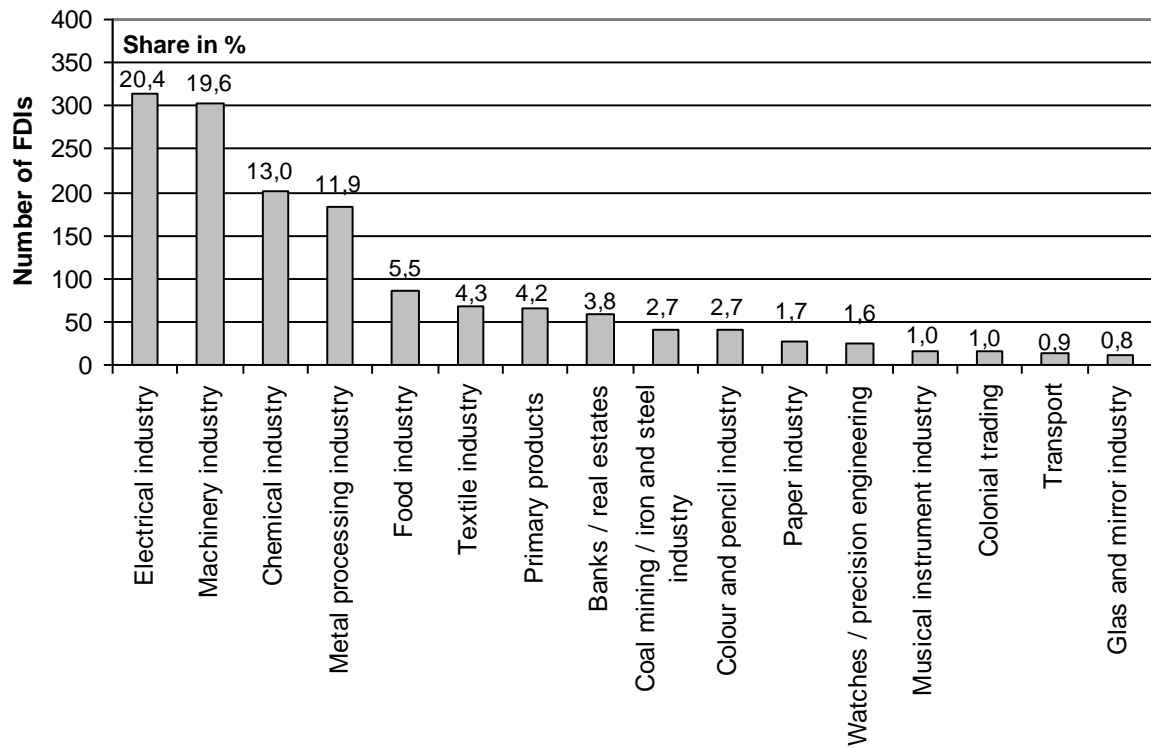
\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

Table 7 reports coefficients based on logit or probit models.

**Table 8** The impact of protection and openness on individual FDI decision

	Sensitivity	Value pre-1914	Value post-1914	Change	Impact
protect	0.0016	12.48	14.56	2.07	0.3%
open	0.0040	9.55	7.98	-1.57	-0.6%
size	0.0087	15.19	14.77	-0.42	-0.4%
roe	0.0430	0.13	-0.11	-0.24	-1.0%
foundation	0.0004	1893.19	1916.84	23.65	0.8%
past_fdi	0.0580	0.37	0.47	0.10	0.6%
HI	0.0030	6.46	23.50	17.04	5.2%
<b>Agglomeration effects</b>					
chemical	0.0013	0.78	0.12	-0.66	-0.1%
electirc	0.0020	1.37	0.33	-1.04	-0.2%
machinery	0.0004	0.83	0.59	-0.24	0.0%
metal	0.0032	0.43	0.21	-0.22	-0.1%
<b>Total impact on propensity to invest</b>					<b>4.5%</b>

Table 8 decomposes the change in the propensity to invest based on the probit model M in Table 7 into partial impacts. Sensitivities refer to marginal effects; hence, the sensitivity indicates the change in the propensity to invest due to a change of the independent variable by one unit. As sensitivities change with the level of the respective independent variable, one has to regard the figures in Table 7 as an approximation to illustrate the magnitude of partial impacts.

**Fig.1** The most important industries and their share in FDI, 1873-1927

**Fig.2** FDI per billion GDP, adjusted for distance and language





## Appendix: Variable definitions and data sources

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### Endogenous variables:

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<i>log</i> ( <i>invest<sub>jt</sub></i> )	Natural logarithm of aggregated FDI flows between Germany and the respective host country (indexed j) at time t. We convert FDI flows into German currency and deflate using Hoffmann's price index; thus, FDI is expressed in real terms. <u>Data source:</u> Amount of investment was deflated, using Hoffmann's price index (1965, p.601, col.15).
<i>fdi<sub>it</sub></i>	We measured the binary choice of individual FDI; hence, the dummy variable takes the value one if firm (indexed i) conducted FDI in year t.

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### Explanatory variables (for the KC model):

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<i>sum_gdp</i>	We calculated the sum of Germany's and the host country's GDP: $\ln(\text{GDP}_f) + \ln(\text{GDP}_{\text{Home}})$ . <u>Data source:</u> Maddison (1995).
<i>dispersion</i>	To indicate the degree of similarity in terms of market size, we defined the dispersion index as follows: $(\ln(\text{GDP}_f) - \ln(\text{GDP}_{\text{Home}}))^2$ . <u>Data source:</u> Maddison (1995).
<i>distance</i>	Distance between Berlin and the host country's capital in km <u>Data source:</u> <a href="http://www.maclester.edu/research/economics/PAGE/HAVEMAN/Trade.Resources/Data/Gravity/dist.txt">http://www.maclester.edu/research/economics/PAGE/HAVEMAN/Trade.Resources/Data/Gravity/dist.txt</a>
<i>language</i>	The dummy variable takes the value of 1 if German is the official language of the host country and zero otherwise.
<i>patents</i>	The variable is defined as the number of foreign patents, which have been extended (so-called high-value patents), of companies of the host country in Germany. This indicator should highlight the degree of technological progress of the host country. <u>Data source:</u> Kaiserliches Patentamt (1875-1927).
<i>enrollment</i>	We used primary school enrollment rates in percent. To measure the skill difference, we calculated the difference of the host country's enrollment rate and the top 25% of all host countries ( <i>enrollment</i> ); thus, a negative value indicates that the respective host country has lower enrollment rates compared to the leading 25% of host countries. <u>Data source:</u> Benavot and Riddle (1988) and Lindert (2004)
<i>wagediff</i>	We determined the difference in real wages of the host country compared to Germany; $\ln(\text{wage}_{\text{Home}}) - \ln(\text{wage}_f)$ . Hence, a positive value indicates that the host country has lower real wages than Germany. <u>Data source:</u> Williamson (1995).
<i>protect</i>	We measured protection by the average tariff rate, which is defined as the ratio of custom revenues to the total value of imports. <u>Data source:</u> Accominotti and Flandreau (2006), Clemens and Williamson (2004) and Rubio (2006).
<i>openness</i>	We determined the ratio of the value of merchandise exports relative to GDP. Standard practice is to add imports and exports and divide by GDP – but we do not have reliable import data for 1873-1927. We use Maddison's (2003) data for 1870, 1913 and 1929 on merchandise exports to construct the openness indicator (exports/GDP). <u>Data source:</u> Maddison (2003).

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### Additional explanatory variables (for logit/probit models):

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<i>size</i>	We used the natural logarithm of total equity as measure for firm size
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<i>ROE</i>	Return on equity as a measure of firm's profitability was defined as net income (distributable to common shareholders) divided by total common equity (excluding preferred equity).
<i>foundation</i>	Year of establishment when joint stock company entered share register.
<i>past_fdi</i>	Indicator variable which takes the value one if the firm invested abroad during the last 10 years and zero otherwise.
<i>HI</i>	The standardised Herfindahl Index shows the level of market concentration in the respective industry. We determined the sum of squared market shares (SSMS) based on total equity (as industry revenue figures are not available) and standardized as follows: $(SSMS - \min(SSMS)) / (\max(SSMS) - \min(SSMS)) * 100$ .
<i>chemical/ electric/ machinery/ metal</i>	Used as industry dummy variables, except in table 7 as we determined industry agglomeration effects defined as the number of FDI conducted by the industry within the last decade in the respective host country.  The individual industries listed in the source on which have companies were:  asphalt baths banks real estate breweries cement chemicals iron and coal electrotechnical dyes other finance gas grain mills glass other raw material rubber colonial goods other food machinery/engineering metal processing musical instruments food processing oil mills optical instruments

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paper and printing  
petrol  
porcelain  
gun powder  
chocolate  
other  
toys  
starch  
textiles  
railways and urban commuting  
clocks  
other transports  
insurance

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Main data source (except mentioned in the table above):  
Handbuch der deutschen Aktiengesellschaften (1897-1901, 1912, 1927).